SEVERAL STATISTICAL PROPERTIES OF GALAXIES WITH UV EXCESS

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ABSTRACT. The number of galaxies with UV excess relative to normal galaxies is determined and other statistical characteristics of galaxies with UV excess are also presented.

V.A. Ambartsumian's idea of the activity of galaxy nuclei, suggested 30 years ago, has played a great role in the development of extragalactic astronomy. He showed that the evolution of galaxies depended on the activity of their nuclei. According to Ambartsumian (1958) the nuclei of galaxies are active if explosions take place in them. These explosions lead to large radio fluxes and in general to the wide range of phenomena normally associated with nuclear activity.

The spectra of active galaxies show ultraviolet (UV) excess and emission lines of hydrogen and other elements. In other words, the UV excess and emission lines which are observed in the spectra of galaxies are the consequence of active processes.

1. THE DISCOVERY OF GALAXIES WITH UV EXCESS

Many galaxies with UV continuum have been discovered by Markarian (1967) on the 40" Schmidt telescope of Byurakan Observatory with a $1^{\circ}.5$ objective prism (the inverse dispersion at Hβ is 2500 Å/mm). He and his collaborators discovered 1500 galaxies with UV continuum.

Our purpose was also to discover new galaxies with UV excess on the 40" Schmidt telescope of Byurakan Observatory with the $1^{\circ}.5$ objective prism using more sensitive emulsions - Kodak 103a-E, Kodak IIa-E and Kodak IIa-F. Many of the IIa-F plates were baked.

We observed 87 fields each covering an area of 17.2 square degrees. In total, all fields cover an area of approximately 1500 square degrees. The fields were selected so that the galactic latitudes of their centres were $|b| > 20^{\circ}$. The limiting magnitudes of the objects observed ranged from 16^{m} to 18^{m}.

The survey of these plates allowed us to discover more than 700 galaxies with UV excess and the results for 580 new galaxies have already been published (Kazarian M.A. 1979a,b; Kazarian M.A. and Kazarian E.S. 1980, 1982, 1983).

E. Ye. Khachikian et al. (eds.), Observational Evidence of Activity in Galaxies, 81–86.

2. THE RELATIVE QUANTITATIVE GALAXIES WITH UV EXCESS

It is very important to estimate the number of galaxies with UV excess relatively to the number of normal galaxies. Such estimations have been made by many authors.

For this purpose we studied our survey plates and marked the spectra of 3147 galaxies. From these galaxies 604, or 19%, are galaxies with UV excess. In addition, 10 plates were selected for detailed study, with limiting magnitudes ranging from 17^m to 18^m, and covering an area of approximately 170 square degrees. On these plates we marked the spectra of 1550 galaxies, of which 286, or 18.5% have UV excess. We conclude that approximately 19% of all galaxies for which we have obtained objective prism spectra have UV excess.

This result is important since it permits us to draw the conclusion that the stage of UV excess is a frequent and long-lasting phenomenon in the life of galaxies.

According to Ambartsumian's ideas about the activity of galaxy nuclei, this conclusion allows to understand that the active processes in galaxies, which lead to the origin of the UV excess, last for a very long time, approximately one fifth of the total lifetime of galaxies.

Takase and his collaborators discovered, on survey plates obtained on the 105 cm Schmidt telescope of Kiso Observatory in the UGR colours, 1100 galaxies with UV excess (Takase 1980), or approximately 25% of all the galaxies they observed. This quantity is close to our estimations.

Over a total surveyed area of 15000 square degrees, Markarian and collaborators found 1500 UV excess galaxies or one for every 10 square degrees. In our own survey we found 700 UV galaxies or 2 per square degree. This compares very well with the 1.68 galaxies per square degree we found in our deep survey and the 1.69 UV galaxies per square degree found by Takase et al. (1980) for a surveyed area of 650 square degrees.

3. THE SPECTRAL AND MORPHOLOGICAL PROPERTIES OF THE NEW GALAXIES WITH UV EXCESS

Slit spectra of more than 100 galaxies from our lists (Kazarian M.A. 1979a,b; Kazarian M.A. and Kazarian E.S. 1980, 1982) have been obtained with the SAO 6 m telescope. For 120 galaxies from these lists direct photographs have been obtained at the prime focus of the 2.6 m telescope of Byurakan Observatory (original scale 20"/mm) and at the prime focus of the SAO 6 m telescope (original scale 8".7/mm).

The morphological structure and the spectral properties of these galaxies are quite diverse. They are of all Hubble types - ellipticals, spirals and irregulars - and many are stellar and compact. Many galaxies of this sample have starlike nuclei or bright central regions. In these galaxies condensations are observed, most of which are superassociations.

In the spectra of about 80% of these galaxies emission lines of hydrogen, [SII], [NII], [OII], [NeIII] and other ions are observed. About 9% of these objects are Seyfert galaxies. In the spectra of many of them the emission lines are very strong and sharp. The spectra of

several galaxies have lines which are observed in emission as well as in absorption.

4. THE DEPENDENCE BETWEEN ABSOLUTE PHOTOGRAPHIC MAGNITUDES AND LINEAR DIAMETERS OF THE GALAXIES WITH UV EXCESS AND OF THE SUPERASSOCIATIONS OBSERVED IN THEM

The relation between luminosity and linear diameters for galaxies with UV excess and for condensations observed in these galaxies is of great importance and deserves special attention. In order to address this question it is enough to build a graph, which establishes the dependence between the absolute integral magnitudes and the linear diameters of the objects. For this purpose we must use accurate values of integral magnitudes and of linear diameters for galaxies as well as for condensations.

For 66 Zwicky galaxies included in our lists the integral photographic magnitudes are known. Slit spectra of these galaxies have been obtained at the SAO 6 m telescope and other telescopes. Direct photographs of these galaxies have been obtained at the 2.6 m telescope of Byurakan observatory and at the SAO 6 m telescope. Using these data, absolute photographic magnitudes Mpg and linear diameters D have been obtained using a Hubble constant of H_o = 75 km/sec/Mpc.

The values Mpg and D are plotted in Fig. 1. From this figure it follows that a weak dependence between Mpg and D is observed, though with a very large dispersion. Assuming that the dependence between Mpg and D is linear and using the method of minimal squares we obtain the following fit to the data,

$$Mpg + 0.075\ D + 18.96 = 0\ . \qquad (1)$$

In Fig. 1 the graph of this equation is represented by a solid line.

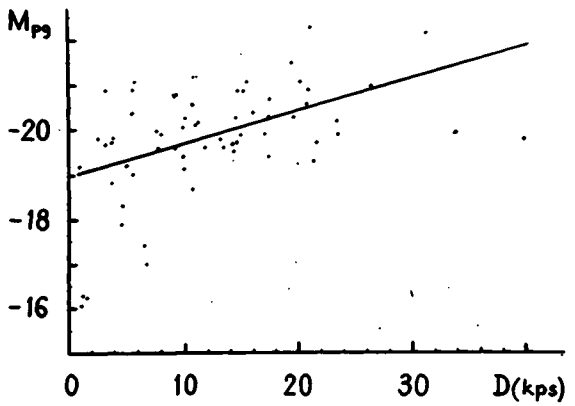

Fig. 1: The dependence between Mpg and D of the galaxies with UV excess.

https://doi.org/10.1017/S0074180900154932 Published online by Cambridge University Press

Now we consider the dependence between Mpg and D for condensations observed in the galaxies with UV excess. Most of these condensations have properties of superassociations. We consider only the condensations for which the absolute magnitude is Mpg $\geq -18^m$, which we consider to be superassociations (Kazarian 1984). In that paper we found the dependence of Mpg with D and of surface brightness mpg/□" with D for 46 superassociations. 22 of these superassociations are observed in galaxies with UV excess and the data for 24 superassociations are presented in Shahbazian (1970).

Fig. 2 presents plots of Mpg versus D and of mpg/□" versus D. If we suppose that the relations presented in this figure have linear character, using the method of the minimal squares we obtain

$$Mpg + 1.53\ D + 13.87 = 0 \qquad (2)$$

$$mpg/□" - 0.91\ D - 19.9 = 0\ . \qquad (3)$$

In Fig. 2 the crosses are the data from Shahbazian (1970), the triangle is 30 Dor, and the points and circles are the data obtained by us. From Fig. 2 it follows that 30 Dor is very near to these lines, though its data were not included in the calculations.

In addition to these 46 objects we obtained data for 30 condensations, which are also observed in galaxies with UV excess. The data for all of these (76) objects cover a wider range in absolute magnitudes (from $-12^m.7$ to $-18^m.0$) and in linear diameters (from 0.2 to 2.6 kpc). In Fig. 3 the data of Mpg and D for these 76 objects are presented. Only some of these objects are associations; the others are superassociations. In this figure the crosses are the data by

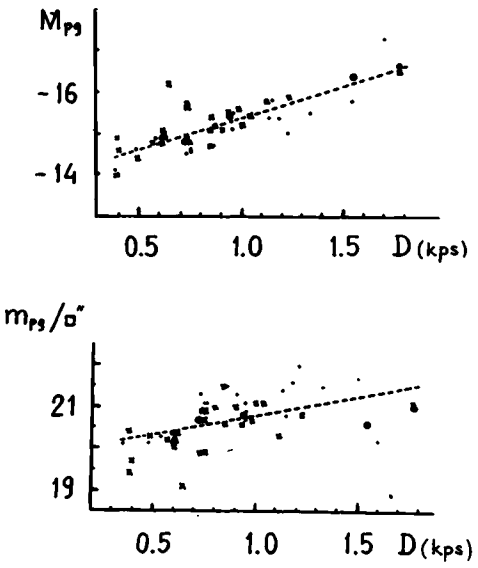

Fig. 2: The dependence between Mpg, mpg/□" and D for 46 superassociations.

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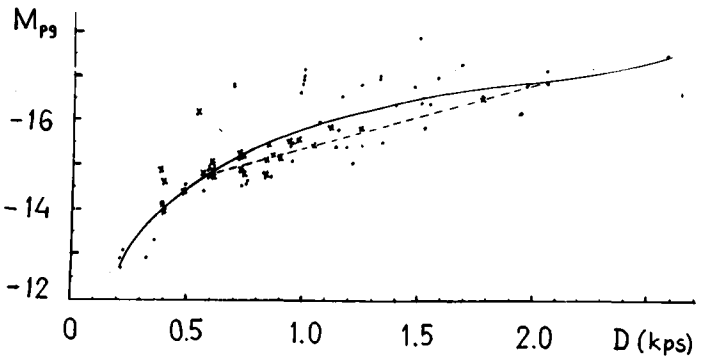

Fig. 3: The dependence between Mpg and D for 76 superassociations.

Shahbazian (1970), points are our data and the circle is 30 Dor. In this figure the dependence does not have a linear character. We represented it as a function

$$Mpg = \sum_{k=0}^{n} a_k D^k \tag{4}$$

Using the method of minimal squares the coefficients a_k of this equation have been obtained. The calculations have been carried out on the computer "Elektronika"-28. The equation for n=6 has the form

$$Mpg = -9.3250-23.4730D+42.3700\ D^2-42.8930\ D^3+ 23.1880\ D^4\ -6.2610\ D^5+0.6619\ D^6\ . \tag{5}$$

The common appearance of this equation is

$$Mpg = -C_o + \sum_{k=1}^{n} (-1)^k\ C_k\ D^k \tag{6}$$

where $C_k > 0$.

In Fig. 3 the equation (5) is represented by a solid line. One can see that this equation reproduces the dependence between Mpg and D very well. In Fig. 3 equation (2) is represented by a dashed line. As we know this equation is correct in the interval of the linear diameters D from 0.4 to 1.9 kpc. One can see that in this interval the linear diameters D and the differences in Mpg obtained by equations (2) and (5) are not more than $0^m.5$. In Fig. 3 30 Dor is very near to the line representing equation (5).

The equation (6), which establishes the dependence between Mpg and D has very important cosmogonical meaning. It leads us to the conclusion that objects which emits great energy have great diameters. If we suppose that in the course of time the diameters of the associations and superassociations change, then equation (6) leads us to a new conclusion, that these objects expand.

https://doi.org/10.1017/S0074180900154932 Published online by Cambridge University Press

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